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A safe substrate?

Investigating the virulence of *Verticillium* in hammer-milled shade trees when used as an alternative substrate

By Heather Stoven, Jim Owen and Luisa Santamaria

Ornamental and fruit tree growers in the Pacific Northwest commonly have surplus biomass generated from grading and inventory management. The wood waste has historically been burned whole or chipped before incorporating into the soil.

Due to new and unique economic constraints, nurseries are considering new uses for wood waste biomass. The use of hammer-milled, culled bare-root trees is one new potential alternative that research at Oregon State University's North Willamette Research and Extension Center is currently exploring.

Greenhouse trials in 2009 and 2010 evaluated the use of processed culled shade trees as an alternative or extender of Douglas fir bark, which is used

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The leaves of this containerized eggplant start show the symptoms of verticillium vascular wilt disease, which is caused by a soil-borne pathogen.

as the primary substrate component for containerized production. The study was carried out by incorporating varying ratios of shade trees hammermilled to less than 3/8 inch minus for growing geraniums. Geraniums were utilized as an indicator for short term crops where substrate stability is not a concern.

The trials found that although large percentages of shade tree biomass reduced growth, moderate additions up to 33 percent by volume had little impact on root or shoot dry weight or visible appearance. Although the addition of culled shade tree into containerized plant material looked promising, we postulated that there existed the potential spread of vascular wilt caused by *Verticillium* spp.

Vulnerable to verticillium?

Before continuing with further work using shade tree as a Douglas fir bark extender, it was decided to first explore the transferability of verticillium from shade trees to susceptible plant material.

Verticillium vascular wilt disease is caused by multiple species of the fungus *Verticillium*. Verticillium wilt, caused by a soil-borne pathogen, is a common and destructive disease that affects a broad range of shade tree species.

In North America, *Verticillium* also causes wilt in a number of other economically important crops that include vegetables, fiber, fruit and nut trees, legumes, forest trees, and woody and herbaceous ornamentals.

The pathogen produces two types of spore structures: short-lived conidia, and overwintering structures called microsclerotia. One of the reasons that *Verticillium* can be such a formidable disease is due to the longevity of microsclerotia in the soil and lack of symptomology with the onset of disease. The microsclerotia have been recorded to survive in the soil up to 14 years.

Foliar disease symptoms, when they appear, include leaf chlorosis and wilting caused by the clogging of the water-conducting tissues. The symptomatic clogged xylem tissue can sometimes be observed by cutting into the stem longitudally, exposing the vascular tissue and observing dark streaking. Common nursery-grown tree species susceptible to this pathogen include several species of maple (*Acer* spp.: silver, Norway, red, Japanese and sugar maple), ash (*Fraxinus* spp.), a number of *Prunus* spp., and redbud (*Cercis canadensis*).

Methodology

In order to investigate the likelihood of infected shade tree biomass transferring the pathogen *Verticillium* to host plants, a greenhouse study was initiated in 2011.

Nine soilless substrates comprised of combinations of zero, 50 percent and 100 percent (by volume) sterilized and non-sterilized Douglas fir bark and *Verticillium*-containing culled shade trees were used to grow containerized eggplant (*Solanum melongena* var. *esculentum*) 'Black Beauty'. Eggplant was chosen due to the quick growth of the crop as well as its known susceptibility to *Verticillium*.

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These shade trees have verticillium leaf wilt. The symptoms are caused by the *Verticillium* pathogen, which clogs the vascular systems of plants so that moisture and nutrients don't get through as effectively.

Symptomatic trees were collected from a local source and chipped. A sample of the chipped material was isolated via culture in the laboratory and identified as *V. dahliae* prior to experiment initiation.

Eggplant seedlings were potted into the experimental substrates and after six weeks of growth in the greenhouse, shoot growth and vascular symptomology was rated, shoot dry weight was determined and stem and leaf tissue from each treatment were collected and isolated in the lab to verify disease presence.

After approximately a month of plant growth, disease symptoms were visible on eggplant foliage. Symptomology included stunting, lower leaf chlorosis and wilt.

Overall, the substrate treatments that included chipped, infected shade trees were rated as showing more disease symptoms and produced less shoot growth. However, ratings of vascular streaking symptomology proved more reliable for showing the presence or absence of disease based upon the laboratory culture results.

Each of the treatments containing non-sterilized shade trees, either 50 or 100 percent, resulted in the transfer of *V. dahliae* to the eggplant.

Further investigation

To further examine the transferability of *V. dahliae* using culled shade trees, we decided to repeat the study in the summer of 2011 using only 30 percent infected shade tree to 70 percent Douglas fir bark. We also used a different experimental design, allowing us to get clearer results from the laboratory culture data.

The repeated experiment had results similar to the first; however, shoot symptomology was less apparent and did not yield significant differences. As before, vascular streaking symptomology was more visible in eggplant stems from treatments containing material infected with *V. dahliae*.

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This eggplant start is infected by *Verticillium dahliae*, as evidenced by the vascular streaking that's visible in this cut-open stem.

In the laboratory, of the 90 tissue samples cultured for disease, 14 percent tested positive for the transfer of *V. dahliae* to the eggplant. Tissue samples from eggplant that were planted into sterilized, chipped shade tree did not test positive for disease.

Even when including relatively small percentages of *V.dahliae*-infected shade tree into a container with susceptible plant material, disease transfer can take place.

Conclusions

Although most growers make an effort to remove diseased materials from inclusion as a source of reused media, this study has shown that plant shoots can often be asymptomatic. Although looking for xylem streaking is a far more reliable indicator of disease, this also is not always conclusive. Trying to pinpoint *Verticillium*-diseased trees while growing in the field may be more labor intensive and less exact than previously thought.

It has been reported that soil pasteurization treatments at temperatures between 40–50 C for a duration of 30 minutes kill several species of soil-borne pathogens, including *Verticillium dahliae* structures (Bollen, 1985). However, it remains unclear if common practices used in the Willamette Valley, such as composting chipped material or stockpiling alone is able to kill the fungus, and further investigation is needed.

Until we obtain more precise information about the effect of composting to control verticillium, other management practices should also be considered, such as planting resistant species, rotating crops in the field or not planting susceptible species in areas where verticillium has previously been found.

Lastly, caution should be employed when using susceptible tree species as a soil amendment or substrate component. This is because of the inability to always see symptoms on infected trees, and because of the persistence of the disease.

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Additional Reading:

Bhat, R.G. and K.V. Subbarao, 1999. Host range specificity in *Verticillium dahliae*. Phytopathology, Vol 89, No. 12. Pages?

Bollen, G.J. 1985. Lethal temperatures of soil fungi. Pages 191-193. In Ecology and management of soil-borne plant pathogens. C.A. Parker, A.D. Rovira, K.J. Moore, P.T.W. Wong, J.F. Kollmorgen, eds., Am. Phyto. Soc., St. Paul, MN.

Hiemstra, J.A. 1998. Some general features of Verticillium wilts in trees. Pages 5-11. In: A compendium of Verticillium wilts in tree species. J.A.Hiemstra and D.C. Harris, eds. CPRO-DLO, Wageningen, The Netherlands.